Claims

[c1] Spherical agglomerates in a size range of from 5 to 100 microns comprising a mixture of a major portion of ultrafine titania particles and a minor portion of corrosion-resistant second-phase ultrafine particles immiscible with the titania.

[c2] The agglomerates of claim 1 wherein the mixture includes from 5 to 45 volume percent, by total volume of the particles, of the second-phase ultrafine particles, wherein the second-phase particles are selected from the group consisting of zirconia, tantalum oxide, boron carbide, silicon carbide, titanium carbide, diamond and combinations thereof.

[c3] An ultrafine titania coating bonded directly on a titanium substrate.

[c4] The coating of claim 3 having a thickness of from 100 to 500 microns.

[c5] The coating of claim 3 wherein the coating has been ground and polished and has a thickness of from 100 to 200 microns.

[c6] The coating of claim 3 comprising a grain growth-inhibiting proportion of a second phase material immiscible with the titania.

[c7] The coating of claim 3 comprising from 5 to 45 volume percent of a material selected from the group consisting of zirconia, tantalum oxide, boron carbide, silicon carbide, titanium carbide, diamond and combinations thereof.

[c8] A nanostructured titania coating with a ground and polished surface on a titanium substrate wherein the titania coating has a grain size less than 500 nm.

[c9] A method for applying an ultrafine titiania coating, comprising the steps of:

(a) preparing agglomerates comprising a mixture of ultrafine titania and second-phase particles, wherein the ultrafine second-phase particles are immiscible with titania, corrosion resistant and comprise a minor proportion of the particles;

(b) thermally spraying the agglomerates onto a substrate surface to deposit a coating of ultrafine titania thereon;

(c) optionally grinding and polishing the coating.

[c10] The method of claim 9 wherein the substrate comprises titanium.

[c11] The method of claim 9 wherein the mixture comprises from 5 to 45 volume percent, by total volume of the particles, of ultrafine particles selected from the group consisting of zirconia, tantalum oxide, boron carbide, silicon carbide, titanium carbide, diamond and combinations thereof.

[c12] A ball valve for handling very corrosive fluids and abrasive solid particles in a pressure leaching process, comprising:

a valve body;

a ball centrally positioned in the valve body and having a central passage rotatable in the valve body between open and closed positions;

at least one seat disposed between the ball and the valve body;

wherein the ball and seat each comprise a titanium substrate and an ultrafine titania coating.

[c13] The ball valve of claim 12 wherein the coating comprises a titania phase and a phase immiscible with the titania phase in a proportion effective to inhibit grain growth.

[c14] The ball valve of claim 13 wherein the immiscible phase comprises from 5 to 45 percent by volume of the coating.

[c15] The ball valve of claim 13 wherein the immiscible phase is selected from zirconia, tantalum oxide, boron carbide, silicon carbide, titanium carbide, diamond and combinations thereof.

[c16] The ball valve of claim 12 wherein the coating has a thickness from 100 to 500 microns.

[c17] The ball valve of claim 12 wherein the titania has a grain size less than 500 nm.

[c18] The ball valve of claim 12 wherein the coating has a ground and polished surface.

[c19] The ball valve of claim 18 wherein the coating is deposited by thermal spray

application of a powder comprising spherical agglomerates in a size range of from 10 to 45 microns comprising a mixture of ultrafine particles of less than 0.3 microns.

[c20] A pressure acid leaching process comprising alternately opening and closing the ball valve of claim 11 to respectively allow and stop passage of an acid leach mixture comprising abrasive particles in a solution of at least 98 percent sulfuric acid at a temperature above 250 ° C and pressure above 4000 kPa.

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[c21] A system for applying an ultrafine titiania coating, comprising:

means for preparing agglomerates comprising a mixture of ultrafine titania and second-phase particles, wherein the ultrafine second-phase particles are immiscible with the titania, corrosion resistant and comprise a minor proportion of the particles;

a reservoir comprising a charge of the titania agglomerates;

means for thermally spraying the agglomerates from the reservoir onto a substrate surface to deposit a coating of ultrafine titania thereon.

[c22] The invention of claim 1 wherein the ultrafine particles are nanostructured.

[c23] The invention of claim 3 wherein the coating is nanostructured.

[c24] The invention of claim 9 wherein the ultrafine particles are nanostructured.

[c25] The invention of claim 12 wherein the ultrafine particles are nanostructured.

[c26] The invention of claim 20 wherein the ultrafine particles are nanostructured.

[c27] The invention of claim 21 wherein ~~the~~ ultrafine coating is nanostructured.

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